Space Weather Technical Forecast

Issued on Sunday, 21 July 2024 at 01:19 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Isolated M-class flares likely. Chance of G1 Minor Storms Day 3 (23 Jul).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Moderate activity through the last 24 hours with two M-flares observed. The latest flare was M1.5 at 20/1849 UTC from AR3744 in the northwest. There are currently up to fourteen sunspot regions on the visible disc. The largest and most complex region remains AR3751, with three distinct large and mature spots. Its trailing region is slightly expanding northwards and a delta spot remains visible in its central portion. Right to the east of AR3751 is AR3761. This region is expanding longitudinally, with a proliferation of intermediate spots. It may also have some influence on the magnetic structure of AR3751, with the potential to bring additional instability to the southern centre disk, as large magnetic looping is observed between these regions. The only other region of note is AR3759 in the southwest but its trailing and intermediate portions are both fading, the group gradually losing spots whilst becoming smaller in size. All other regions are either small and/or simple.

No Earth-directed CMEs have been observed in coronagraph imagery.

Solar Wind / Geomagnetic Activity: Slow wind conditions have largely persisted, with minor perturbations and very small discontinuities, these indicative of weak transients. Solar winds, as observed by ACE at L1, were at background levels, between 330-380 km/s, with a mostly below average density. The Interplanetary Magnetic Field (IMF), Bt, was mostly Weak but became briefly Moderate between 20/0815-1000 UTC, peaking at 10 nT. The north-south component, Bz, was largely positive, ranging between +6/-4nT. Phi angle was variable. Geomagnetic activity was Quiet throughout (Kp 1-2).

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux observed by GOES18 remained at Background. High energy electron flux (greater than 2MeV) observed by GOES16 was at Background. The 24-hour fluence was well below Active, with 9.9e5 integrated pfu observed at 21/0001UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate with further M-flares likely and a slight chance of X-class flares, mainly from AR3751, however, isolated flares are possible from other regions across the disc.

Solar Wind /Geomagnetic Activity: The two CMEs that were observed leaving the sun on the 16 July are overdue and therefore considered too slow to generate any significant impact to Earth's geomagnetic field. Another CME has the potential to arrive early on Day 3 (23 Jul). There is currently no influence from any coronal hole fast speed stream and no obvious source of enhancement in the next few days. Consequently, geomagnetic activity is expected to be mostly Quiet with a chance of Active or even G1 / Minor Storm intervals on Day 3 (23 Jul) due to CME effects.

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Energetic Particles / Solar Radiation: High energy proton flux is most likely to remain at background levels, but with a slight chance of rising above the S1/Minor Storm threshold in response to any notable flare, most likely from AR3751 as it moves across the western hemisphere. High energy electron flux is expected to remain at background with the associated 24hr fluence expected to persist below Active.

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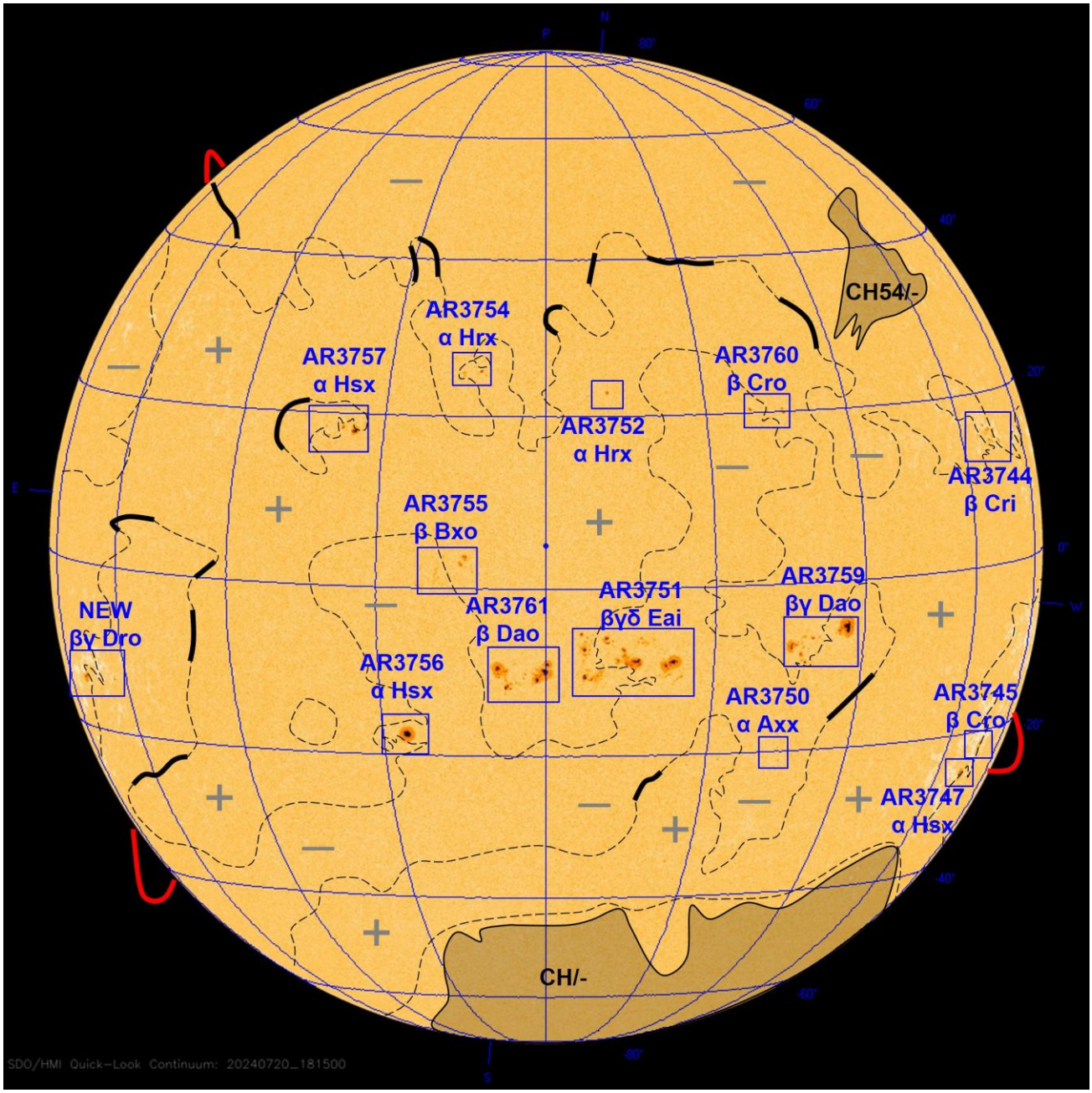
Figure 1. Solar Analysis Valid 20/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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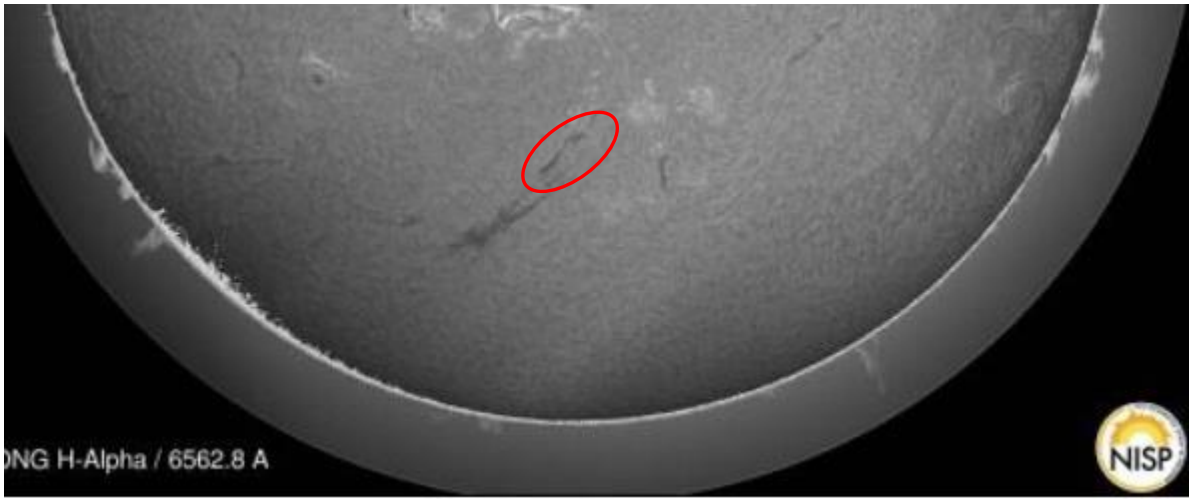
Geomagnetic Storms:

The two CMEs that were observed leaving the sun on the 16 July, in association with the M1.9 flare from AR3744, are overdue and therefore considered too slow to generate any significant impact to Earth's geomagnetic field. Another option would be that they missed Earth in their path. Another CME has the potential to arrive early on Day 3 (23 Jul) from the filament eruption that was observed late on 19 July. This feature can be seen as the second of two eruptions leaving to the southeast, and although faint, some material may be Earth directed.

Figure 2: Cerro Tololo GONG image showing the portion of the filament that is considered to be Earth-directed at 19/1901 UTC just before it erupts



In terms of coronal hole, there is no compelling evidence of any influence from CH54/- or the large coronal crown situated in the southern hemisphere. Consequently, aside from the potential CME arrivals Day 1 and Day 3 (21 and 23 Jul), solar winds are expected to remain at background level.

All things considered, geomagnetic activity is expected to be mostly Quiet with a chance of Active or even G1 / Minor Storm intervals on Day 3 (23 Jul) due to CME effects.

Geo-Magnetic Storm / Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	40	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
20/0400	Partial	Filament eruption	S-Centre	615 km/s	23/0800 UTC +/- 9 hrs	Northern portion of filament eruption, second of the two

Radio Blackouts - X-Ray Flares:

There are currently up to fourteen sunspot regions on the visible disc. The largest and most complex region remains AR3751, with three distinct large and mature spots. Its trailing region is slightly expanding northwards and a delta spot remains visible in its central portion. Right to the east of AR3751 is AR3761. This region is expanding longitudinally, with a proliferation of intermediate spots. It may also have some influence on the magnetic structure of AR3751, with the potential to bring additional instability to the southern centre disk, as large magnetic looping is observed between these regions. The only other region of note is AR3759 in the southwest but its trailing and intemediate portions are both fading, the group gradually losing spots whilst becoming smaller in size. All other regions are either small and/or simple.

Low to Moderate with further M-flares likely and a slight chance of X-class flares, mainly from AR3751, however, isolated flares are possible from other regions across the disc.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	50	50	50	50
Very Active	R3 to R5 X Class	No	5	5	5	5

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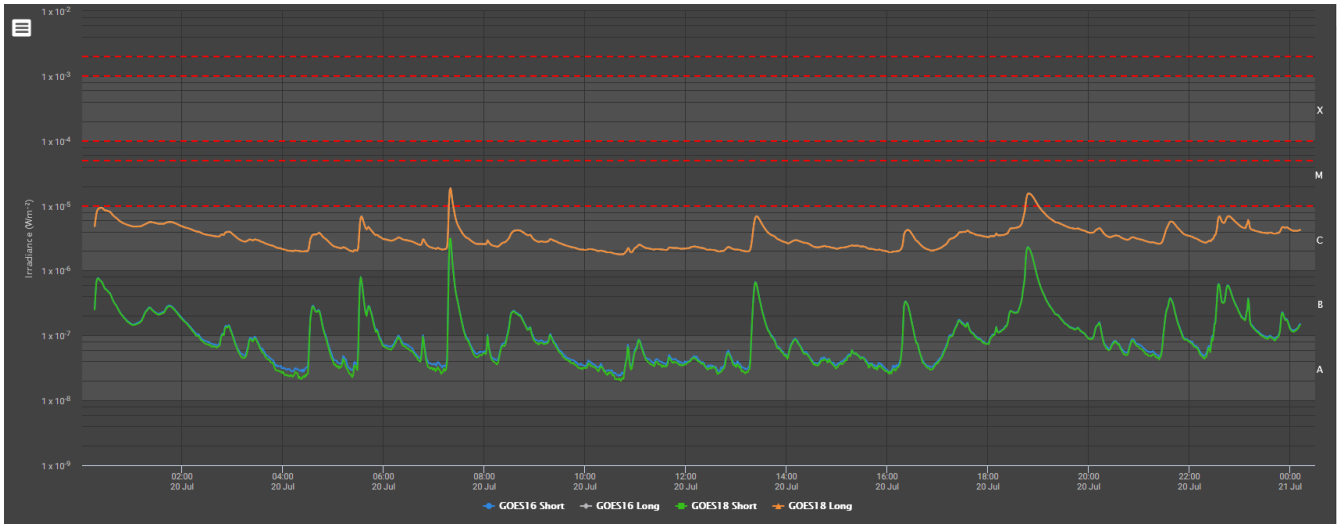
Figure 3: Latest X-Ray flare activity, as observed at GOES-16/18



Solar Radiation Storms - (High Energy Protons):

GOES-18 proton flux remains at background levels, with no solar radiation storms observed. However, any significant flare, particularly from any of the three larger regions (AR3751, AR3761 or AR3759) in the western disc have the potential to increase the observed flux and brings a chance of exceeding the S1 Minor Storm threshold. The probability increases slightly over time as these regions move into the better connected solar western hemisphere, where high energy protons have a greater likelihood of reaching Earth via the Parker Spiral.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	15	15	15
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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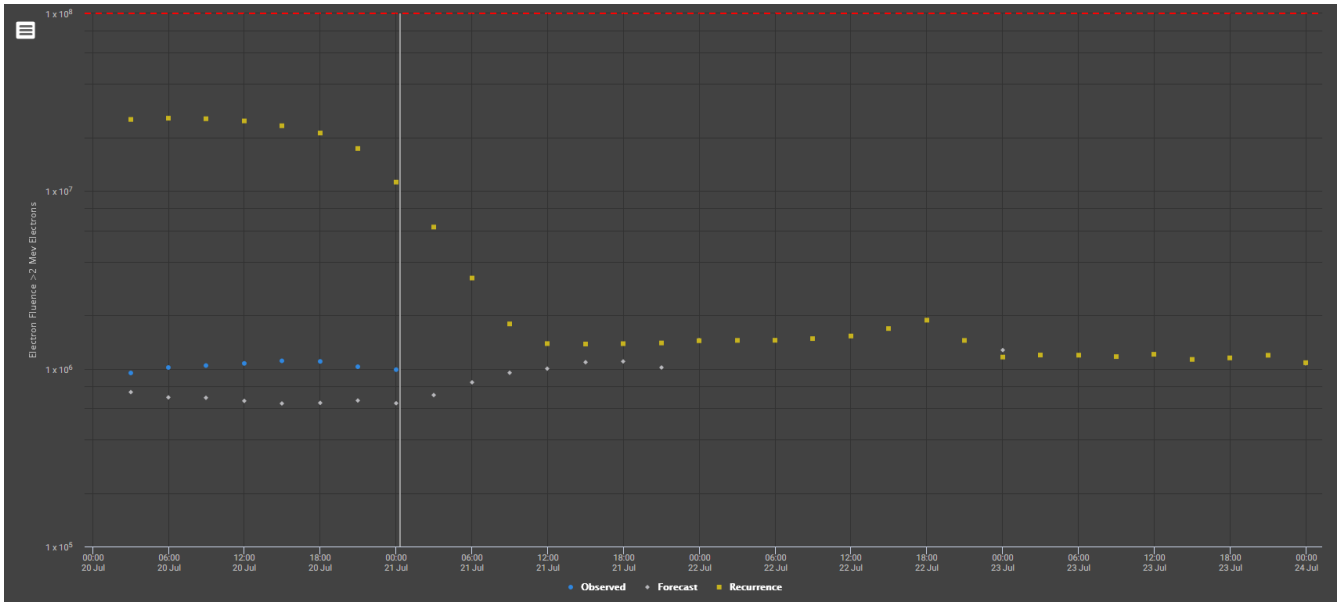
High Energy Electrons Event (≥ 2MeV):
The high energy electron flux as observed by GOES-16 is currently at background and is expected to persist at this level given the lack of any notable source of enhancement. The CME that is expected to arrive on Day 3 (23 July) has the potential to increase significantly the solar wind speed however, it will most likely take another day for the Van Halen belts to replenish and reach Moderate or even High levels. In other words, the Fluence is very unlikely to see the Active threshold being breached during this period and the latest MOSWOC REFM is considered to provide good guidance.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: Latest MOSWOC REFM output



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